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# Hydrogen Safety Codes, Standards and Regulations Overview

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International Standards

Office of Hazardous Materials Safety

Research and Special Programs Administration

US Department of Transportation



Hydrogen  
Economy  
Workshop  
Cairo, Egypt  
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2005





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# Outline

- **Definitions**
- **Participants**
- **Development Process**
- **Need for Codes and Standards**
- **Issues/Barriers and how to resolve**
- **Government role in RD&D**
- **Government Technical Regulations**
- **IPHE Role**





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# Definitions

- **Codes**

- Specify requirements, components, and procedures for use
- Developed through voluntary code publishing groups
- Usually established/adopted by jurisdictions
- Legally binding; i.e. building codes
- International codes set by agreement





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# Definitions

- **Standards**

- Technical definitions, guidelines, and instructions for design, manufacture, and testing
- Set minimum performance or component requirements
- Technical experts from industry and governments
- International standards are typically voluntary, consensus based; i.e. equipment standards





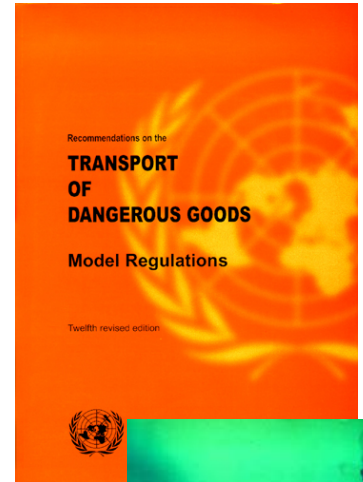
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# Definitions

- **Regulations**
  - Legally binding, developed through national administrative process or international agreement
  - Typically incorporate by reference safety codes and standards
  - Developed in advance of deployment and commercialization to protect public safety





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# Performance vs. Prescriptive Code/Standard

- **Performance code/standard**
  - Not specific to any given application
  - Set high-level requirements, but may not define specific requirements or thresholds for various applications
- **Prescriptive code/standard**
  - Specific to a given use
  - Components may not be suitable for use in other applications

# Major Participants

## • Codes

- ICC  
International  
Code Council
- NFPA  
National Fire  
Protection  
Agency
- ASME  
International  
American  
Society of  
Mechanical  
Engineers

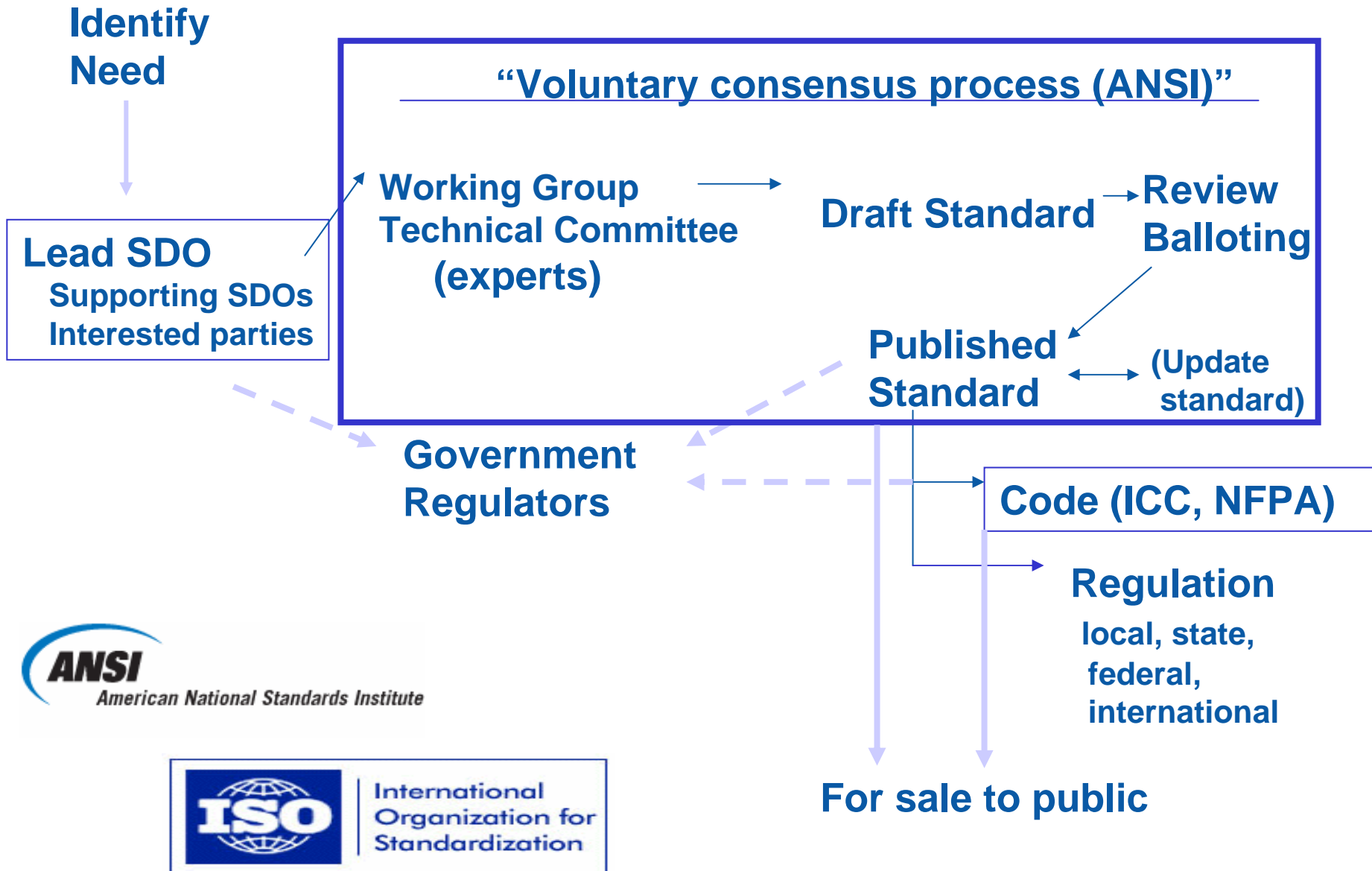
## • Standards

- IEC International  
Electrotechnical  
Commission
- ISO International  
Organizations for  
Standardization
- ANSI American  
National Standards  
Institute
- SAE Society of  
Automotive Engineers

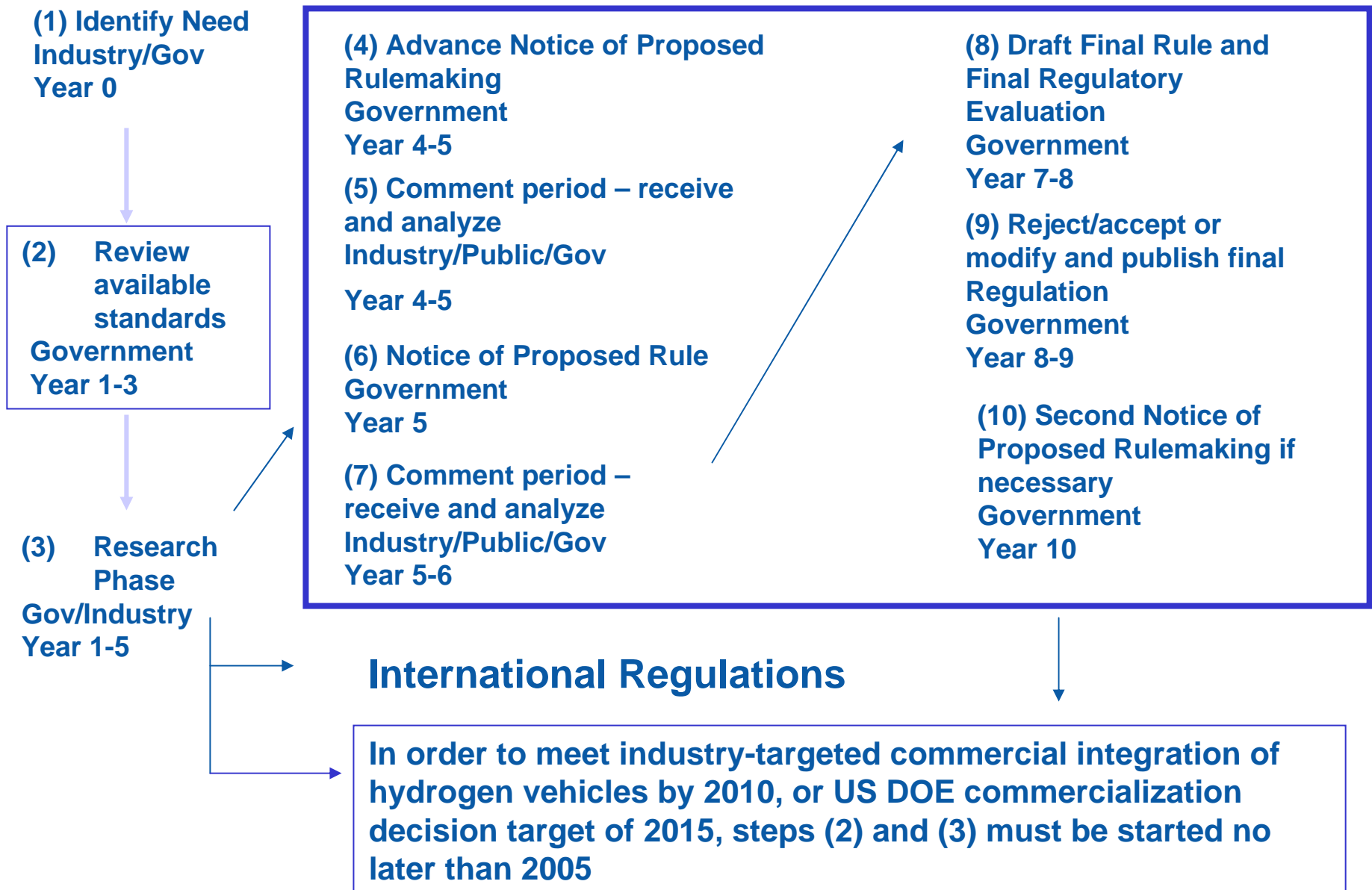
## • Regulations

- UNECE WP.29  
World Forum for  
Harmonization of  
Vehicle Regulations
- UN ECOSOC  
Sub-Committee of  
Experts on the  
Transport of  
Dangerous Goods
- National  
Governments  
  
US DOT, EPA

# Example Standard Development Process



# Example Regulatory Development Process





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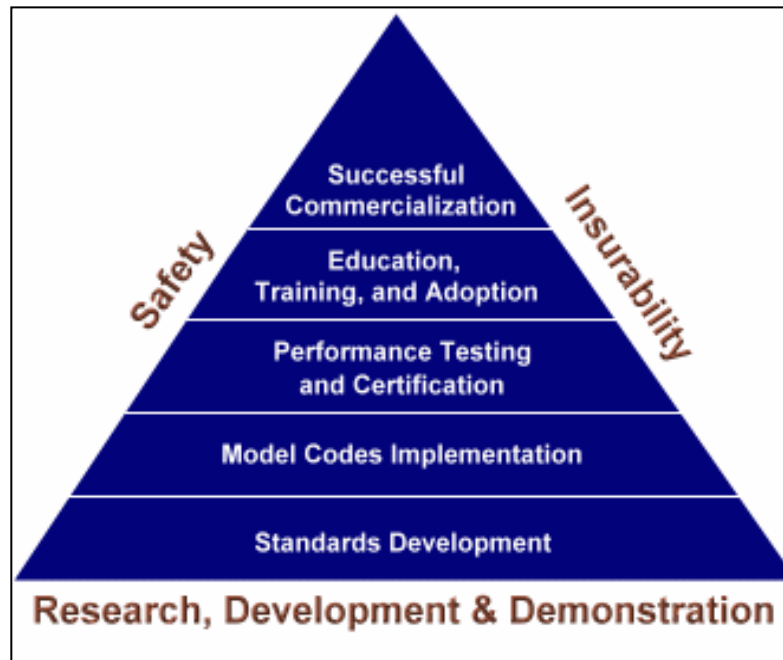
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# Need for Codes and Standards

- **Safety assurance**
- **Public confidence**
- **Enable commercialization**





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# Issues

- **Hydrogen has been used and transported safely for many decades**
- **Current standards tend to be based on industrial experience rather than consumer/commercial use by the public**
- **Tendency to adopt industrial standards to transport**
- **Insufficient technical data available**



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# Major Barriers

- **Complex system of development**
- **Overlapping and competing standards**
- **Manufacturers are driven by need to sell product**
  - Debate on control of standard
  - Drive to target standard to accommodate a specific product
- **Usage and language are precedent setting – may compromise long-term safety or limit technology**
- **International standards still have limited governmental development role**
- **Large number of local government jurisdictions (approx 44,000 in U.S.)**
- **Non-uniform training of officials**



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# Goals and Objectives

*Perform underlying research to facilitate the development and harmonization of international codes and standards.*

- **Assess sufficiency of international hydrogen and fuel cell codes and standards – both established and in the process**
- **Identify information needs**
- **Maintain an R&D roadmap designed to fill information gaps**
- **Insure information developed is available to codes and standards developing organizations**



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# Approach

- **Perform underlying R&D**
- **Assess current practices and status of technical development efforts**
- **Support of performance-based, non-prescriptive Codes and Standards development that facilitate technology introduction, but do not hinder future technology evolution**
- **Identify gaps and needs between current efforts and those necessary for performance-based standards**
- **Determine resources needed to collect and disseminate critical information to codes and standards groups**
- **Advance international effort to develop and adopt an R&D roadmap for a Global Technical Regulation**



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# Government Role

*Because of the large number of interested parties, those which represent competitive entities and that are both national and international, governments are uniquely positioned to facilitate progress toward harmonized codes and standards and improved safety*

- **Lead non-competitive basic research**
- **Coordinate international participation**
- **Facilitate relationships among cooperative and competing industries**
- **Publish and disseminate results**
- **Educate Codes and Standards officials, first responders, and policy makers**



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# 4 Key Target Research Areas

- **Hydrogen Behavior**
  - physical/chemical, combustion and flammability, material properties, sensing/mitigation
- **Vehicles**
  - Fuel storage system, components, sensors, whole vehicle performance, failure modes
- **Infrastructure**
  - Production, distribution and delivery, fueling stations
- **Interface**
  - Fuel quality, refueling components

***Roadmap details Needs or Gaps for each Target Area to ensure RD&D efforts are properly directed***



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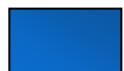
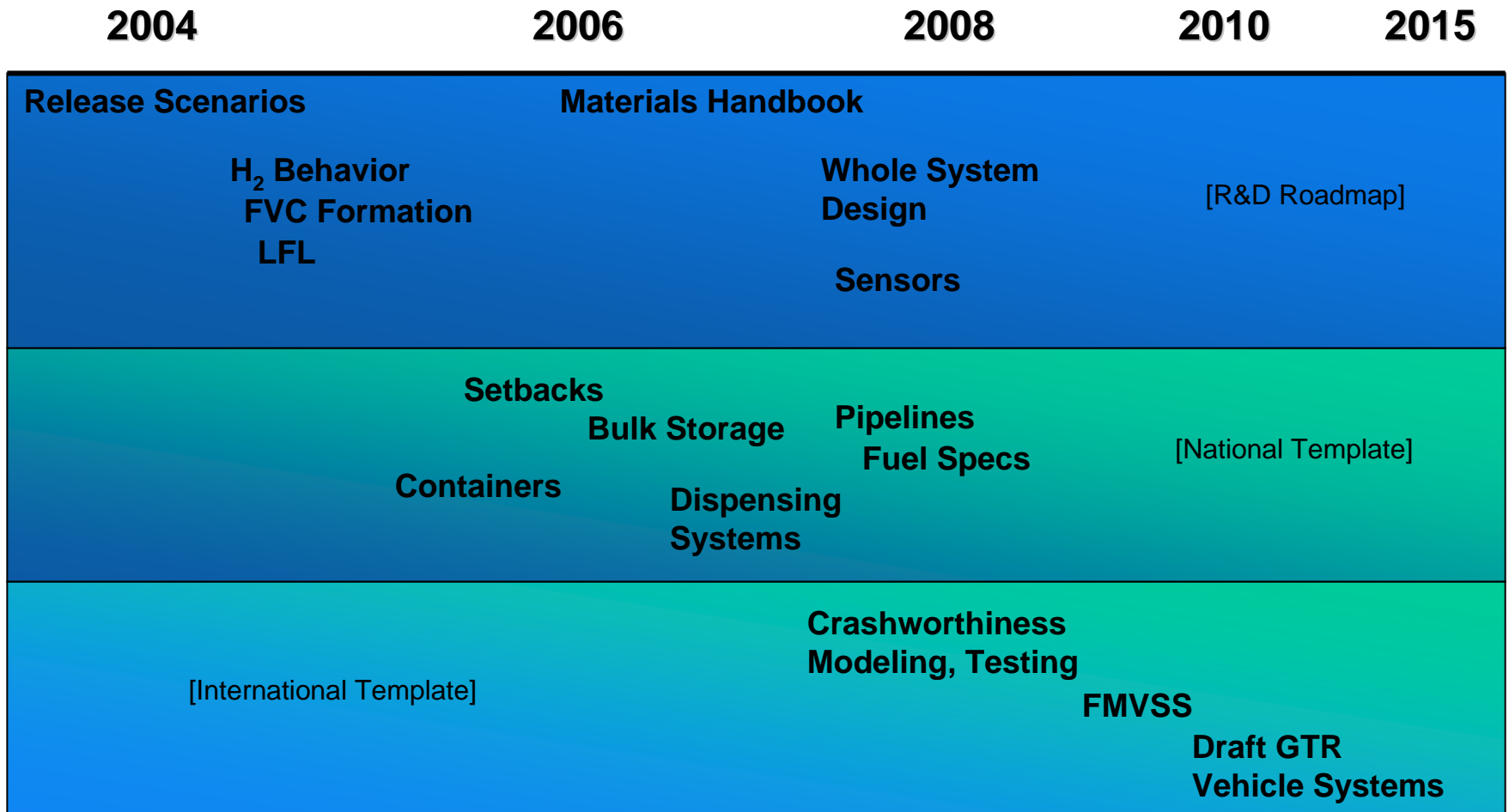
# Vehicle R&D Roadmap Timeline

## RD&D Roadmap Timeline (2005)

“Completed By” dates shown

Information Need Areas	2005	2006	2007	2008	2010	2015
Properties	©					<b>Final Code Development Period (2010 – 2015) to meet Commercial- ization Decision of 2015</b>
FVC Formation, LFL		©				
Jets and Flames		©				
LH <sub>2</sub> Releases			©			
Materials Compatibility			©			
Metal Hydride Materials, Behavior				©		
H <sub>2</sub> Sensors				©		
H <sub>2</sub> Tank Testing		©				
H <sub>2</sub> Refueling Tests			©			
Life-cycle Testing					©	
P-Relief Devices			©			
P-T Sensors			©			
On-board fuel handling				©		
Parking Certification			©			
<b>Hydrogen Behavior</b>						
<b>Hydrogen Vehicle</b>						

# Overall Timetable



R&D



Codes and  
Standards



Regulations

Commercialization  
Decision



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# Government Technical Regulations

- **Global Technical Regulation framework for fuel cell vehicles under UNECE 1998 Agreement**
  - Consensus based
  - Flexible to allow application to all countries, regardless of approval process
  - Existing international standards incorporated by reference
  - EU, US, Canada, Japan, and numerous other non-EU countries are signatories
  - At least 5 year development process
- **Alternative component standard development**
  - Design specific
  - Limit future technology



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# IPHE Activities



*The IPHE represents a major opportunity for international cooperation on Codes and Standards activities*

- **Scoping Paper is a critical document to shape future Codes and Standards international cooperation**
- **Global communication and facilitation**
- **Opportunity to promote performance-based global standards and regulations that enable technology introduction while allowing evolution**



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# Conclusion

- **Safety of hydrogen can be addressed through comprehensive testing, certification, and functional standards**
  - just like with any other fuel
- **Coordination is the key**
- **Ultimate commercialization and technology decisions will be made by the commercial sector, governments must provide the regulatory and safety framework within which these choice can be made**